SVKM's
D. J. Sanghvi College of Engineering

Program: B.Tech in Mechanical Engineering **Academic Year: 2022** **Duration: 3 hours**
Date: 14.01.2023
Time: 10:30 am to 01:30 pm
Subject: Quality Engineering (Semester V) **Marks: 75**

Instructions: Candidates should read carefully the instructions printed on the question paper and on the cover page of the Answer Book, which is provided for their use.
(1) This question paper contains three pages.
(2) All questions are compulsory.
(3) All questions carry equal marks.
(4) Answer to each new question is to be started on a fresh page.
(5) Figures in the brackets on the right indicate full marks.
(6) Assume suitable data wherever required, but justify it.
(7) Draw the neat labelled diagrams, wherever necessary.

<table>
<tr><th>Question No.</th><th></th><th>Max. Marks</th></tr>
<tr><td>Q1</td><td>Answer the following questions (Any three)
i. There may be many dimensions of quality. Given a manufactured product, explain any five important dimensions of quality.
ii. What are the barriers in the successful implementation of TQM?
iii. Write a short note quality trilogy
iv. Explain pareto diagram with suitable example.</td><td>[15]</td></tr>
<tr><td>Q2 (a)</td><td>State the statistical significance of control chart and solve the following.
The data given below are temperature readings from a chemical process in ^{0}C, taken every 10 minutes. Determine the center line, control limits and control charts for ($\bar{\bar{X}}$ and S). What is your conclusion from the control chart? Assume assignable causes for the variation if found and revise the control limits.
(Take A2 = 0.577, A3 = 1.427, B3 = 0, B4 = 2.089, D3 = 0, and D4 = 2.114)
<table>
<tr><th>Subgroup No.</th><th colspan="5">Temperature Readings (Deg.C))</th></tr>
<tr><td>1</td><td>53</td><td>85</td><td>49</td><td>37</td><td>59</td></tr>
<tr><td>2</td><td>45</td><td>73</td><td>41</td><td>46</td><td>39</td></tr>
<tr><td>3</td><td>72</td><td>55</td><td>66</td><td>54</td><td>48</td></tr>
<tr><td>4</td><td>75</td><td>48</td><td>34</td><td>41</td><td>63</td></tr>
<tr><td>5</td><td>70</td><td>57</td><td>37</td><td>33</td><td>73</td></tr>
<tr><td>6</td><td>40</td><td>65</td><td>35</td><td>59</td><td>65</td></tr>
<tr><td>7</td><td>36</td><td>73</td><td>41</td><td>56</td><td>62</td></tr>
<tr><td>8</td><td>42</td><td>43</td><td>37</td><td>49</td><td>43</td></tr>
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(OR)
What is acceptance sampling and when it is preferred? And describe the following terms in connection with sampling method.
AQL, RQL, AOQL, Producer's risk and Consumer's Risk</td><td>[10]</td></tr>
</table>

Q2 (b)	Distinguish between chance and assignable causes of variation in SQC with suitable examples.	[05]
Q3 (a)	A group of researchers decided to conduct experiments in order to reduce the undesirable emissions from a fuel. They identified three different factors, each to be controlled at two levels (low and high). Factor A is the concentration of corn extract, factor B is the concentration of an ethylene-based compound and factor C is the distillation temperature. Four experiments were conducted with three replications at each treatment. The larger the level of emission, the worse the impact on the environment. The results are given below in the table. Determine the response table, response graph and strong effects based on appropriate S/N ratio and average response.	[10]

	Factors and their levels			NC1	NC2	NC3
Trail No.	A	B	C	Emission Level (ppm) From Fuel		
1	1	1	1	30	24	26
2	1	2	2	48	49	46
3	2	1	2	43	47	54
4	2	2	1	30	32	25

(OR)

Answer the following questions.

i. Distinguish between factor, factor levels, treatments, repetitions and replications in the context of design of experiments.

ii. What is orthogonal array? Explain the properties of orthogonal arrays with the help of L-4 OA.

Q3 (b)	A manufacturer of magnetic tapes is interested in reducing the variability of the thickness of the coating on the tape. It is estimated that the loss to the consumer is \$10 per reel if the thickness exceeds 0.05 ± 0.004 mm. 1) what is the appropriate loss function equation? 2) what is loss coefficient k? 3) what is the loss when coating thickness is 0.057mm?	[05]
Q4 (a)	An aircraft manufacturer decides to check the ultimate tensile strength of four different size bolts. Four units were tested for each bolt size under consideration and the measured tensile strength values are given in the table below. Use one-way ANOVA tool to determine if there is any significance difference in the data obtained at a significance level of 0.05. (Refer F-distribution table provided on the last page).	[10]

Bolt Diameter (in)	Tensile strength (MPa)			
0.250	120	123	122	119
0.375	131	128	126	140
0.500	115	124	123	120
0.625	118	119	121	120

(OR)

Explain steps involved in two sample t test of hypothesis testing.

Q4 (b)	Differentiate control factors and noise factors with suitable examples.	[05]
Q5 (a)	Describe DMAIC methodology of problem solving in service/manufacturing sector.	[10]
Q5 (b)	Elaborate the following double sampling plan.	[05]

	N = 800, n_1= 100, c_1 = 4, n_2 = 60, c_2 = 7 Where N= lot Size, n = sample size, c= acceptance number	

Critical values of F for the 0.05 significance level:

	1	2	3	4	5	6	7	8	9	10
1	161.45	199.50	215.71	224.58	230.16	233.99	236.77	238.88	240.54	241.88
2	18.51	19.00	19.16	19.25	19.30	19.33	19.35	19.37	19.39	19.40
3	10.13	9.55	9.28	9.12	9.01	8.94	8.89	8.85	8.81	8.79
4	7.71	6.94	6.59	6.39	6.26	6.16	6.09	6.04	6.00	5.96
5	6.61	5.79	5.41	5.19	5.05	4.95	4.88	4.82	4.77	4.74
6	5.99	5.14	4.76	4.53	4.39	4.28	4.21	4.15	4.10	4.06
7	5.59	4.74	4.35	4.12	3.97	3.87	3.79	3.73	3.68	3.64
8	5.32	4.46	4.07	3.84	3.69	3.58	3.50	3.44	3.39	3.35
9	5.12	4.26	3.86	3.63	3.48	3.37	3.29	3.23	3.18	3.14
10	4.97	4.10	3.71	3.48	3.33	3.22	3.14	3.07	3.02	2.98
11	4.84	3.98	3.59	3.36	3.20	3.10	3.01	2.95	2.90	2.85
12	4.75	3.89	3.49	3.26	3.11	3.00	2.91	2.85	2.80	2.75
13	4.67	3.81	3.41	3.18	3.03	2.92	2.83	2.77	2.71	2.67
14	4.60	3.74	3.34	3.11	2.96	2.85	2.76	2.70	2.65	2.60
15	4.54	3.68	3.29	3.06	2.90	2.79	2.71	2.64	2.59	2.54
16	4.49	3.63	3.24	3.01	2.85	2.74	2.66	2.59	2.54	2.49
17	4.45	3.59	3.20	2.97	2.81	2.70	2.61	2.55	2.49	2.45
18	4.41	3.56	3.16	2.93	2.77	2.66	2.58	2.51	2.46	2.41
19	4.38	3.52	3.13	2.90	2.74	2.63	2.54	2.48	2.42	2.38
20	4.35	3.49	3.10	2.87	2.71	2.60	2.51	2.45	2.39	2.35